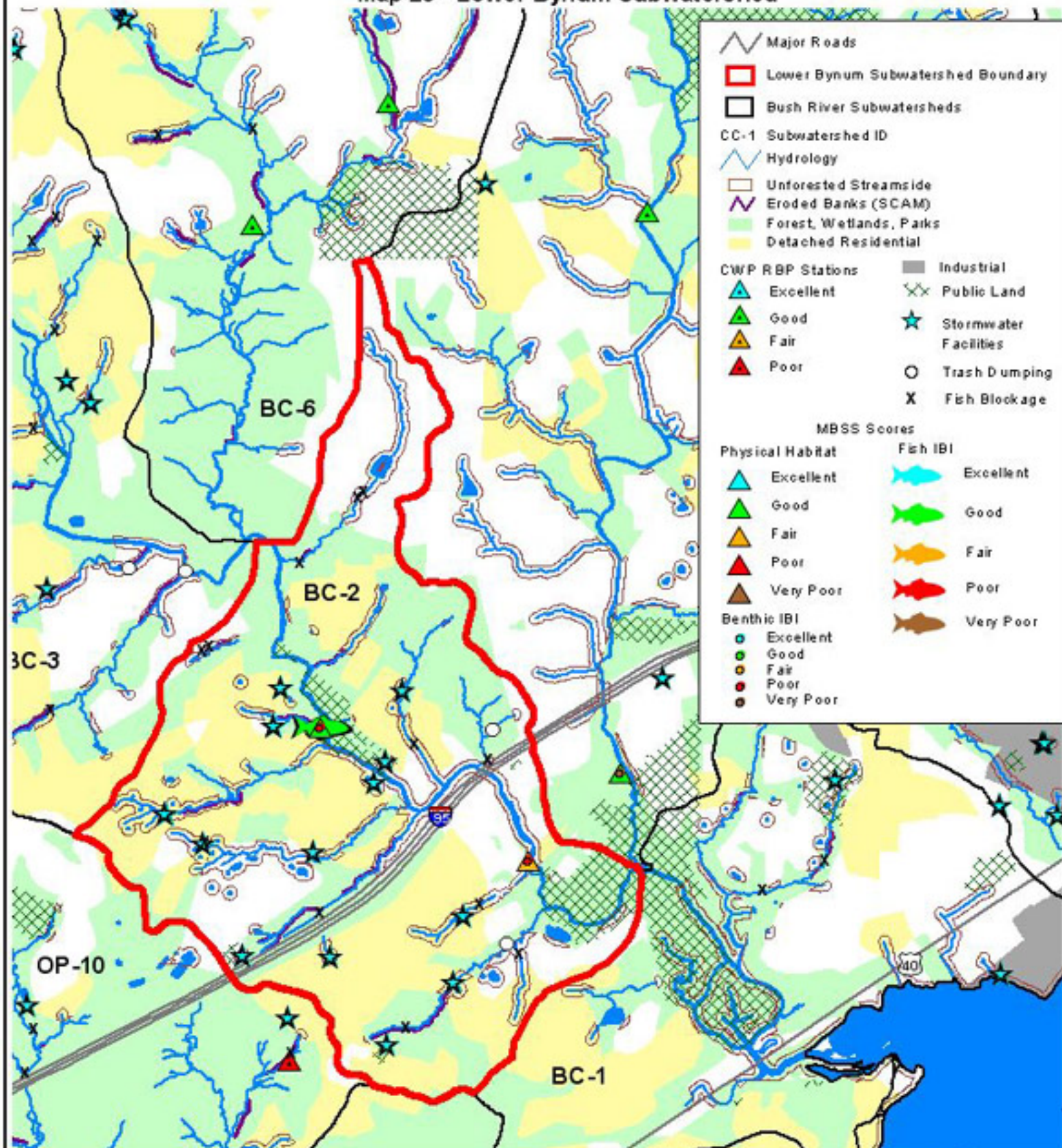


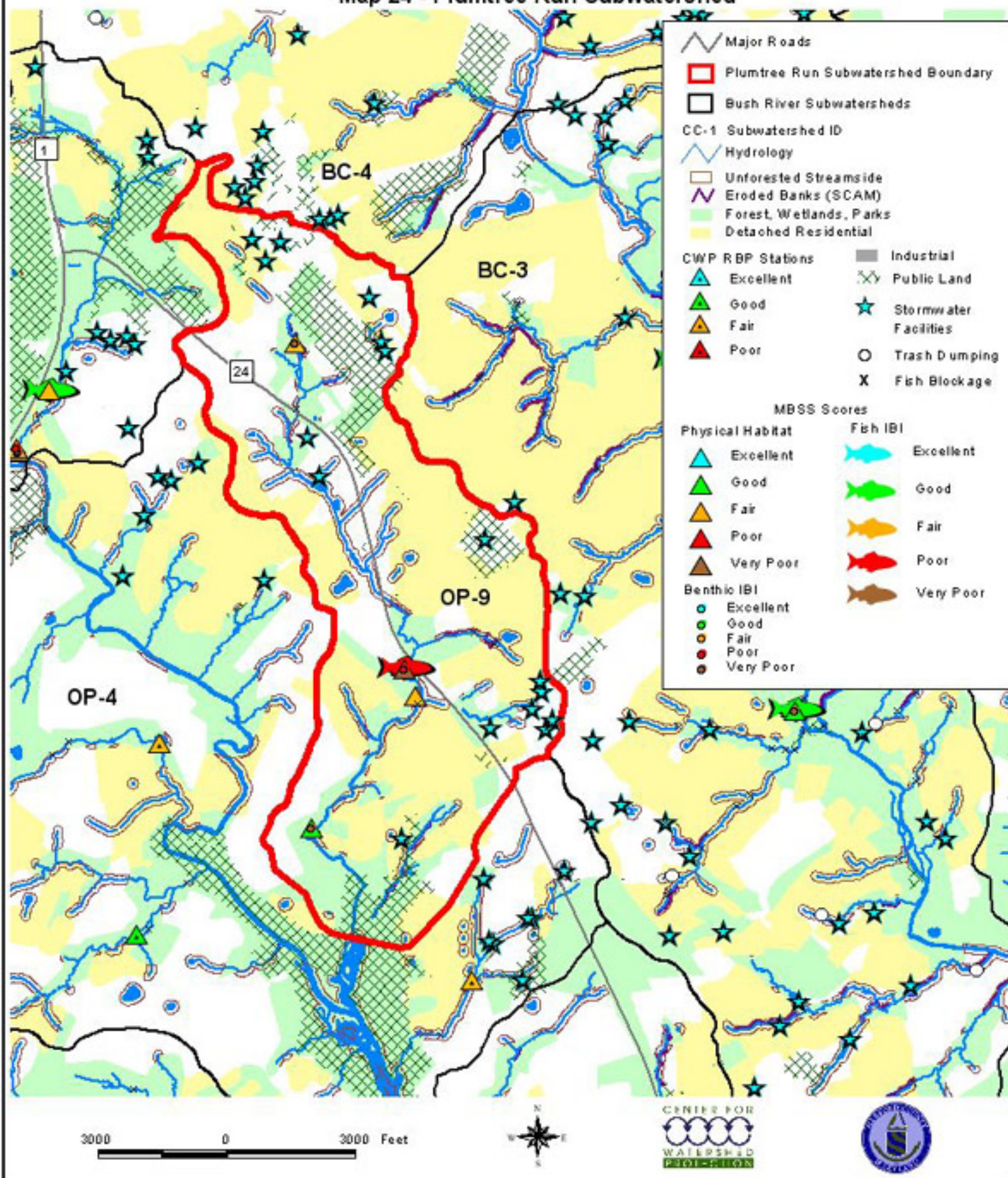
Map 23 - Lower Bynum Subwatershed



2000 0 2000 feet



Map 24 - Plumtree Run Subwatershed



SECTION 4.0 IMPLEMENTATION

In this section, the recommendations have been broken into three prioritization tiers (Table 19) with the first tier representing the top watershed recommendations. Tier 2 and 3 recommendations should still be pursued, but monetary and staff resources should initially be directed towards Tier 1 recommendations. The prioritization is based on the following factors:

- Does the recommendation affect a priority subwatershed?
- What is the overall benefit to the Bush River watershed health?
- Does the recommendation directly meet WAMP goals?
- Does the recommendation require more assessment or program development?

Given a 10 year planning horizon, Tier 1 recommendations should be implemented within the first five years. The time frame for Tier 2 should roughly be within five to seven and Tier 3 within seven to ten. When certain opportunities such as funding or County and/or State initiatives present themselves, Tier 2 and Tier 3 recommendations should be given priority.

Where possible, planning level cost assumptions for recommendations are summarized. An over-riding assumption is that all recommendations will require some level of staff time, although this cost has not been included in cost per unit.

Table 19. Bush River Subwatershed Implementation Strategy

Tier Rank	Recommendation	Subwatershed Management Classification	Estimated Cost per Unit
1	Grays Run Contiguous Forest Preservation	Sensitive	Land Acquisition: \$20,000/ac ¹ PDR: \$5600/ac ²
1	Grays Run Buffer Enhancement	Sensitive	\$1200/ac ⁵
1	Maintain Grays Run Sensitive Status	Sensitive	PDR: \$5600/ac ² TDR: staff time
1	Reduce Livestock Access in Little East Bynum ⁶	Rurally Impacted	Exclusionary fencing: \$4/ft fencing ^{3,5} Off-stream water source: \$2500 ³
1	Coordinate Stream clean-ups within Middle and Lower Bynum	Impacted	Staff time
1	Educate Residents on Watershed Stewardship in Impacted Subwatersheds	Impacted	\$20,000 ⁴
1	Implement Stormwater Retrofits in Impacted Subwatersheds	Impacted	\$4-15K per acre treated
1	Implement Stormwater Retrofits in Impacted Special Resource Subwatersheds	Impacted Special Resource	\$4-15K per acre treated
1	Establish an Implementation Committee	Watershed-wide	Staff time
1	Implement Recommendations of Harford County Site Planning Roundtable	Watershed-wide	Staff time
2	Field Verify and Prioritize Contiguous Forest Areas for Preservation in Sensitive Subwatersheds	Sensitive	Staff time
2	Preserve Priority Contiguous Forests in Sensitive Subwatersheds	Sensitive	Land Acquisition: \$20,000/ac ¹ PDR: \$5600/ac ²
2	Enhance Existing Riparian Buffers in Rurally Impacted Subwatersheds	Rurally Impacted	\$1200/ac ⁵
2	Preserve Contiguous Forests in Lower Winters DD and Cranberry Run	Impacted	Land Acquisition: \$20,000/ac ¹ PDR: \$5600/ac ²

Table 19. Bush River Subwatershed Implementation Strategy

Tier Rank	Recommendation	Subwatershed Management Classification	Estimated Cost per Unit
2	Preserve Contiguous Forest in Haha Branch	Impacted Special Resource	Land Acquisition: \$20,000/ac ¹ PDR: \$5600/ac ²
2	Preserve Large Wetland Tracts in Impacted Special Resource Subwatersheds ⁷	Impacted Special Resource	Land Acquisition: \$20,000/ac ¹ PDR: \$5600/ac ²
2	Develop a Heightened Plan Review in Impacted Special Resource Subwatersheds	Impacted Special Resource	Staff time
2	Streambank Stabilization in Haha Branch and Otter Point Subwatersheds	Impacted Special Resource	\$50-100/liner foot ⁴
2	Foster the Development of a Bush River Watershed Association	Watershed-wide	Staff time
2	Improve ESC Inspection and Enforcement	Watershed-wide	Staff time
3	Preserve Farmland in Rurally Impacted Subwatersheds	Rurally Impacted	Land Acquisition: \$20,000/ac ¹ PDR: \$5600/ac ²
3	Agricultural Practices Assessment in Rurally Impacted Subwatersheds	Rurally Impacted	Staff time
3	Septic System Education in Rurally Impacted Subwatersheds	Rurally Impacted	Staff time
3	Investigate Other Stormwater Retrofit Opportunities in Impacted Subwatersheds	Impacted	Staff time
3	Create a Watershed Stewardship Website	Watershed-wide	Staff time
3	Establish an Adopt-a-Pond Program	Watershed-wide	Staff time
<p>1: Source: Harford County Land Trust 2002 purchase of the woodland surrounding the Anita C. Leight Estuary Center. 2: Source: Loudoun County 2002 PDRs www.loudoun.gov/news/pdrnews.htm 3: Includes cost of post every 10 feet 4: Source: modified from Rapid Watershed Planning Handbook 5: Source: Marshall County, TN NRCS 6: Cost may be covered under CREP 7: Cost of wetland preservation may be lower due to development restrictions already in place by State and County regulations.</p>			

SECTION 5.0 TRACKING SUCCESS AND NUTRIENT AND SEDIMENT LOAD REDUCTION ESTIMATES

This section is broken into two parts, a strategy for tracking the success of the Bush River WAMP and the potential pollutant load reductions as a result of the implementation of the WAMP. Both components should be continually revisited and updated as progress has been made.

SECTION 5.1 TRACKING SUCCESS

This section outlines the strategy the County should take to track the success of the implementation of the Bush River WAMP. The proposed tracking entails four main components, a quantifiable objective, monitoring component, public involvement, and programmatic change. Table 20. provides details on how tracking for these components apply to the WAMP recommendations (See Section 3.0). Where possible, the objective places a quantifiable target for each recommendation. All watershed plans should contain a monitoring component to measure and evaluate the response of the watershed over the course of implementation. Public involvement is an important part of the watershed implementation process for two reasons. Public involvement is necessary for the successful implementation and acceptance of projects (stormwater retrofits, buffer enhancement, etc.) that may be on or adjacent to privately owned land. Secondly, it is also necessary to change the collective behaviors of residents that affect water quality. In table 20, the public involvement component explains how the public can be involved with each recommendation. Programmatic change indicates what modifications may be necessary to Harford County's codes or programs in order to implement a recommendation. Programmatic change may not be relevant in all cases. Table 20 is based on the assumption of a 10-year planning window.

Tracking projects undertaken in the watershed is an effective tool to measure success. The system assists in interpreting changes in subwatershed quality and assessing program performance. A database should be developed that records information such as:

- | | |
|------------------------------|---------------------------------|
| • Project ID | • Date Installed |
| • Project Type | • Description |
| • Cost Share? | • Installer/Contractor name |
| • Total Cost | • Installer/Contractor phone # |
| • Sponsoring Agency | • Inspection Schedule |
| • Subwatershed | • Initial Inspection Date |
| • Property Owner | • Initial Inspection Comments |
| • Property Owner Phone# | • Follow-up Inspection |
| • Property Owner Address | • Follow-up Inspection Comments |
| • Location on Property | • Next Inspection Date |
| • Maintenance Responsibility | |

The tracking data should be summarized and reviewed on an annual basis. This will allow for adjustments in program implementation and incremental assessments of program effectiveness.

Table 20. Tracking Success of the Bush River WAMP

Recommendation	Objective	Monitoring Component	Public Involvement	Programmatic Change
Contiguous Forest Preservation	75% of contiguous forest preserved	Track # of acres preserved	Work with large landowners to put in easement	NR; make use of existing programs such as PDR and TDR
Buffer Enhancement/Restoration	Increase buffers by 40%; 75 miles of buffer created	Track # of miles of buffer planted and # landowners contacted	Awareness education in urban residential areas; volunteer opportunities	New staff to make direct contact with landowners of unbuffered stream segments
Reduce Livestock Access	Reduce known access by 40% ³	Track # of acres of pasture fenced out of streams and linear stream fencing	Work with large landowners to implement	NR
Coordinate Stream Clean-ups	Reduce known sites by 50%	Track # of sites cleaned-up	Work with stakeholders and volunteer groups to implement	NR
Educate Residents on Watershed Stewardship	Educate 40% of homeowners	Nutrient behavior survey before and after education effort ¹	Public is target audience	NR
Implement Stormwater Retrofits	Six stormwater retrofits implemented at a minimum	Track # of retrofits implemented; conduct water quality monitoring before and after	Stakeholder meeting with neighborhood or business before retrofit design	NR
Establish a Bush River Implementation Committee	Establishment of Committee	Track overall progress of WAMP implementation	NR	NR
Implement Recommendations of Site Planning Roundtable	Incorporate recommendations into existing codes and ordinance; Improved COW Score ²	Less impervious cover in new development assessed in GIS	Current stakeholder process has included environmentalists and developers	Changed codes and ordinances
Preserve Wetland Tracts	75% of wetland tracts preserved	Track # of acres of wetlands preserved	Work with large landowners	NR
Develop Heightened Plan Review	Development of Heightened Review	Use SCAM to monitor severity of existing eroded banks and identify any new ones	Possible developer education	Modified plan review for designated areas within the County
Streambank Stabilization	2 miles of stream stabilization	Cross sections taken over time to monitor stability; would include at least one before and after stabilization	Stakeholder meeting with neighborhood or business before stabilization design; could possibly involve stakeholders in implementation	NR
Erosion and Sediment Control Improvements	Less than 10% of sites with repeated installation or maintenance problems	Track reported installation and maintenance problems	Hotline for ESC violations and complaints	Implementation of fines and stop work orders for repeated non-compliance

Table 20. Tracking Success of the Bush River WAMP

Recommendation	Objective	Monitoring Component	Public Involvement	Programmatic Change
Bush River Watershed Association	Establishment of Association	Track # of members	Direct community involvement; creates opportunities to volunteer and educate	NR
Farmland Preservation	50% of farmland preserved	Track # of acres preserved	Work with large landowners to implement	Establish areas as Rural Legacy
Agricultural Practices Assessment	Completion of assessment	Track % of in-place practices	Work with local farmers	NR
Septic System Education	Established Education Effort	Continued Synoptic Surveys	Education of target audience	Inspections at point of sale; pumpouts on at least a 5 yr cycle
Watershed Stewardship Website	Completion of website	Track # of hits	Possible role through writing of content pieces or message board	NR
Adopt-a-Pond Program	Establishment of Program	Track # ponds adopted	Provides volunteer and education opportunities	Program would be addition to DPW's current stormwater management program
<p>Notes:</p> <p>Some recommendations are specific to certain subwatershed classifications and do not necessarily infer watershed-wide implementation. See Section 3.0 for more details. NR: Not relevant.</p> <p>1: See Appendix H for a sample nutrient behavior survey.</p> <p>2: Codes and Ordinance Worksheet (COW); a quantifiable assessment of a community's ability to implement Better Site Design (see Appendix J for Harford County's COW).</p> <p>3: Unidentified access should be addressed as part of the Agricultural Practices Assessment</p>				

SECTION 5.2 TRACKING NUTRIENT AND SEDIMENT LOAD REDUCTION ESTIMATES

Measurable nutrient and sediment reductions based on full implementation of the Section 3 Recommendations of the Bush River WAMP are presented in Table 21. Percent estimations of expected load reductions are based on the planning level use of the Watershed Treatment Model (WTM) Version 3.0 (Caraco, 2000) written for EPA Region 5 and the Technical Reference for Maryland's Tributary Strategies (DNR, 2003). For a number of management measures we were not able to assign a load reduction because of insufficient data or because the measure would result in future benefits that we are not able to quantify in terms of pollutant loads.

The WTM load reductions are presented to estimate the relative benefit of management measures and not an absolute load reduction. Improved load reduction estimates would require reconciling the assumptions of the Technical Reference for Maryland's Tributary Strategies with the Watershed Treatment Model. This is beyond the scope of this project. Nevertheless, the WTM serves as a useful planning level tool that Harford County and/or DNR could use to estimate and track the effectiveness of the implementation of the watershed management plan. The management measures that we can quantify are presented in Table 21. Based on the WTM, lawn care education and increased riparian buffers are critical measures to reduce nutrient loads. Improved erosion and sediment control (ESC), increased riparian buffers, and the combination of stormwater retrofits with stream restoration are critical to reducing sediment loads. It is noteworthy that two of the most effective management measures, watershed education and improved ESC cannot be estimated with the Technical Reference.

Additional management measures that could lead to load reduction estimates or watershed benefits are summarized in Table 22. One example of additional information that would be needed to compute a load reduction associated with nutrient management is the number of acres currently under nutrient management as well as a future estimate of the acres where nutrient would be implemented for both nitrogen and phosphorus. Additional measures that would lead to long-term benefits for the watershed include the preservation of contiguous forest and farmland and an Adopt-a-Pond program.

Table 21. Percent Nutrient and Sediment Reductions based on Full Implementation (Planning Level Estimates)

Management Recommendations	Total Nitrogen (lbs/yr)	Total Phosphorus (lbs/yr)	TSS (lbs/yr)	Comments
Educate Residents on Watershed Stewardship specifically -Lawn Care Education	7%	1.1%	--	Based on research of the effectiveness of different media campaign types (newspaper, cable TV) and the percentage of individuals willing to change behavior (reduced fertilizer application)
Erosion and Sediment Control (ESC) Improvements	--	--	3.4%	Based on improved ESC practice implementation and enforcement -- potential for improvement is based on their MDE program evaluation (MDE, 2002)
Buffer Enhancement/ Restoration	3.7%	1.7%	4.4%	Based on the implementation of 75 miles of stream buffers
Implement Stormwater retrofits	Less than 0.5 %	Less than 0.5 %	Less than 0.5 %	Based on the implementation of 2 retrofits a year for 10 years
Streambank stabilization / retrofits	*Less than 0.5 %	*Less than 0.5%	2.5%	Based on 2 miles of stream stabilization with 80% o the stabilization associated with channel protection retrofits
Total	12%	3%	10.5%	Planning Level Estimates
These planning level estimates are based on the WTM Model Version 3.0 (Caraco, 2000)				
* Estimates based on the Technical Resource Document (DNR, 2003) (estimate does not account for retrofits with channel protection criteria)				

Table 22. Additional Management Recommendations Where Loads or Future Benefits Could not be Quantified

Management Recommendations	Justification
Implement Recommendations of the Site Planning Roundtable	Based on the reduction in IC and a decrease in runoff benefit of Better Site Design can be estimated with the Watershed Treatment Model (WTM)
Reduce livestock access to streams	Based on the number of acres where livestock access is removed -- loads can be generated using Technical Resource Assumptions $TN - (.75 \text{ eff}) * (7.2 \text{ lbs/acre/yr}) - (2.8 \text{ lbs/acre/yr})$ $TP - (.75 \text{ eff}) * (0.2 \text{ lbs/acre/yr}) - (0 \text{ lbs/acre/yr})$ (Assumed to reduce the load of TN and TP by 75% of the pasture load minus the background forest load)
Septic system education	The assumption is that with better education, septic system maintenance would be more frequent and there would be a reduction in failing systems. With information on number of homes on septic, the benefit of an education program can be estimated by the WTM.
Agricultural Practices Assessment -- Nutrient management	In the Technical Reference - nutrient management is expected to reduce loads in the Upper Western Shore by: $N - 4.6 \text{ lbs/acre/yr}$ $P - 0.3 \text{ lbs/acre/yr}$ Mandatory nutrient management for both N & P is expected to be phased in over the next few years
Adopt-a-Pond Program	Though difficult to measure improved maintenance factor and pond performance can be estimated using the WTM.
Farmland Preservation	Reduces the potential increase in loads that can be associated with conversion of farmland to developed land
Preserve Contiguous Forest	Reduces the potential increase in loads that can be associated with conversion of forest to developed land. Contiguous forest is also important for breeding songbirds and wildlife.
Investigate additional stormwater retrofit opportunities	This step is necessary in order to perform additional retrofits
Watershed Stewardship Website	The benefit is not easy to estimate but provides users and public with quick access to good information
Preserve Wetland Tracts	Important to the overall protection of the watershed especially the large tidally influenced wetlands at the mouths of the creeks

SECTION 6.0 CONCLUSION

The large size and rapid rate of development within the Bush River watershed presents a challenge for its effective management. Working closely with DNR and other key partners and stakeholders, Harford County DPW identified the following three major Watershed Restoration Action Strategy (WRAS) objectives:

1. Implement smart growth and low impact development
2. Promote stewardship and community engagement
3. Improve impacted watershed conditions to enhance water quality, aquatic habitats, and the aesthetic quality of the watershed

The Bush River WAMP represents a major component of the comprehensive WRAS, as outlined by Harford County. Specifically, the WAMP identifies and details:

- General management practices that can be applied across similar subwatershed types to improve watershed conditions and reduce pollutant loads
- Specific high quality subwatersheds that should be evaluated for future protection against development and enhancement with respect to riparian buffers and upland preservation efforts.
- Specific impacted subwatersheds within the development envelope that present opportunities for stormwater retrofits.
- Management approaches in both rural and urban subwatersheds that promote and encourage public awareness and involvement.

Utilizing existing data, supported with some additional calculations (current IC, future IC, etc) and field verifications, ten priority subwatersheds were identified within the watershed: Grays Run, Little East Bynum, West Branch, Middle Bynum, Lower Bynum, Plumtree Run, Otter Point DD, Church Creek DD, Bush Creek DD, and Haha Branch.

Recommendations and prioritizations are provided on a subwatershed basis as well as on an individual project or management measure basis (e.g., contiguous forest protection, riparian corridor reforestation, stormwater retrofits, and stream stabilization). Where applicable, the recommendations and prioritization reflect opinions and sentiments of stakeholders that have participated in the discussion and planning process. A basis for implementation with associated cost estimates (in terms of capital dollars and staff needs) is provided for the recommendations. In addition, planning level estimates of potential pollutant load reductions (specifically nutrients and sediment) associated with recommended management measures are provided. As more detailed information and data are generated and compiled, load reduction estimates can be refined to more accurately reflect watershed response. Lastly, the WAMP presents a tracking system that measures progress as recommendations are implemented.

The establishment of an Implementation Committee is recommended to assist the County in following through and tracking the WAMP. The County and Implementation Committee will need to identify sustainable and new funding sources to pursue target projects within the watershed. Partnerships with DNR, SHA, EPA, MDE and others should be thoroughly explored and developed.

Due to the limited scope of this project, detailed field verification and specific restoration project identification and prioritization was not possible. However, future assessment needs are identified in the WAMP (see Section 3.0). Furthermore, as implementation proceeds and additional data are collected, compiled, and assessed, the County and Implementation Committee should regularly revisit and update the WAMP to reflect the most current knowledge of restoration opportunities and watershed conditions. The Bush River WAMP, in conjunction with other WRAS components identified by the County (e.g., revision of development codes, public outreach and education initiatives, etc.), provides a concise and rapid approach to improve existing watershed conditions and protect existing high quality natural resource areas.

SECTION 7.0 REFERENCES

- Bartoldus, C., E. Garbisch, and M. Kraus. 1994. Evaluation for Planned Wetlands. Environmental Concern, Inc. St. Michaels, Maryland.
- Brown, K. and K. Cappiella. 2002. *Impervious Cover and Land Use in the Chesapeake Bay Watershed*. Center for Watershed Protection. Ellicott City, MD.
- Caraco, D. 2001. Watershed Treatment Model (WTM), Version 3.0. Center for Watershed Protection. Ellicott City, MD.
- Center for Watershed Protection. 1998. *Rapid Watershed Planning Handbook*. Center for Watershed Protection. Ellicott City, MD.
- Center for Watershed Protection. 2003. *Impacts of Impervious Cover on Aquatic Systems*. Center for Watershed Protection. Ellicott City, MD.
- DeVivo, J., C. Couch, and B. Freeman. 1997. *Use of Preliminary Index of Biotic Integrity in Urban Streams Around Atlanta, Georgia*. Georgia Water Resources Conference. Atlanta, Georgia.
- Harford County. 2002. *Harford County, Maryland Zoning Code*. Harford County Department of Planning and Zoning. Bel Air, MD.
- Harford Land Trust. 2002. Harford Land Trust Website. Internet Site: <http://landtrust/harfordhasit.com>
- KCI. 1999. Findings and Recommendations Report: Engineering Study for Bynum Run Watershed Harford County, Maryland. KCI. Hunt Valley, MD.
- Loudoun County. 2002. Purchase of Development Rights Program. Internet Site: www.loudoun.gov/news/pdrnews.htm
- Marshall County, TN Natural Resource Conservation Service (NRCS). 2002. Cost Estimates for Cattle Exclusion Systems. Marshall NRCS. Lewisburg, TN.
- Maryland Department of Natural Resources (DNR). 2002. *Bush River Watershed Characterization*. Maryland DNR. Annapolis, MD.
- Maryland Department of Natural Resources (DNR). 2003. Technical Reference for Maryland's Tributary Strategies (Documentation for Data Sources and Methodologies Used in Developing Nutrient Reduction and Costs Estimates for Maryland Tributary Systems). DNR. Annapolis, MD.
- Maryland Department of the Environment (MDE), Water Management Administration. 2002. Harford County Erosion and Sediment Control Evaluation. MDE. Baltimore, MD.

Maryland Department of the Environment (MDE). 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD

Maryland Department of the Environment (MDE). 2003. *Maryland's 303(d) List*. Internet site: <http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/index.asp>

US Environmental Protection Agency (EPA). Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers, Periphyton, Benthic Macroinvertebrates and Fish. Second Edition. EPA. Washington, D.C.